CPC COOPERATIVE PATENT CLASSIFICATION

F28F DETAILS OF HEAT-EXCHANGE AND HEAT-TRANSFER APPARATUS, OF GENERAL APPLICATION (water and air traps, air venting F16)

F28F 1/00 **Tubular elements; Assemblies of tubular elements** (specially adapted for movement F28F 5/00)

F28F 1/003 . { Multiple wall conduits, e.g. for leak detection (leak-detection in metal cooled nuclear reactor steam generators F22B 1/066)}

F28F 1/006 . {with variable shape, e.g. with modified tube ends, with different geometrical features (F28F 1/025, F28F 1/06, F28F 1/08, F28F 9/16, F28F 9/18 take precedence)}

F28F 1/02 . Tubular elements of cross-section which is non-circular (F28F 1/08, F28F 1/10 take precedence)

F28F 1/022 . . {with multiple channels }

F28F 1/025 . . {with variable shape. e.g. with modified tube ends, with different geometrical features (F28F 1/06, F28F 1/08, F28F 9/16, F28F 9/18 take precedence)}

F28F 1/04 . . polygonal, e.g. rectangular {(F28F 1/022 takes precedence)}

F28F 1/045 . . . {with assemblies of stacked elements}

F28F 1/06 . . crimped or corrugated in cross-section

F28F 1/08 . Tubular elements crimped or corrugated in longitudinal section

F28F 1/10 . Tubular lements and assemblies thereof with means for increasing heat-transfer area, e.g. with fins, with projections, with recesses (crimped or corrugated elements F28F 1/06, F28F 1/08)

F28F 1/105 . . {the means being corrugated elements extending around the tubular elements}

F28F 1/12 . . the means being only outside the tubular element

F28F 1/122 . . . {and being formed of wires}

F28F 1/124 . . . {and being formed of pins}

F28F 1/126 . . . {consisting of zig-zag shaped fins (F28F 1/105 takes precedence)}

F28F 1/128 . . . . {Fins with openings, e.g. louvered fins}

F28F 1/14 . . . and extending longitudinally (F28F 1/38 takes precedence)

F28F 1/16 . . . . the means being integral with the element, e.g. formed by extrusion (F28F 1/22 takes precedence)

F28F 1/18 . . . . . the element being built-up from finned sections

F28F 1/20 . . . . the means being attachable to the element (F28F 1/22 takes precedence)

F28F 1/22 . . . . the means having portions engaging further tubular elements

F28F 1/24 . . . and extending transversely (F28F 1/38 takes precedence)

F28F 1/26 . . . . the means being integral with the element (F28F 1/32 takes precedence)

F28F 1/28 . . . . . the element being built-up from finned sections

F28F 1/30 . . . . the means being attachable to the element (F28F 1/32 takes precedence)

F28F 1/32 . . . . the means having portions engaging further tubular elements

F28F 1/325 . . . . . {Fins with openings}

F28F 1/34 . . . and extending obliquely (F28F 1/38 takes precedence)

F28F 1/36 . . . . the means being helically wound fins or wire spirals

F28F 1/38 . . . and being staggered to form tortuous fluid passages

F28F 1/40 . . the means being only inside the tubular element

F28F 1/405 . . . {and being formed of wires}

F28F 1/42 . . the means being both outside and inside the tubular element

F28F 1/422 . . . { with outside means integral with the tubular element and inside means integral with the tubular element (F28F 1/424 takes precedence)}

F28F 1/424 . . . { Means comprising outside portions integral with inside portions}

F28F 1/426 . . . . { the outside portions and the inside portions forming parts of complementary shape, e.g. concave and convex}

F28F 1/44 . . . and being formed of wire mesh

F28F 3/00 **Plate-like or laminated elements; Assemblies of plate-like or laminated elements** (specially adapted for movement F28F 5/00)

F28F 3/005 . {Arrangements for preventing direct contact between different heat-exchange media (F28F 3/10 takes precedence)}

F28F 3/02 . Elements or assemblies thereof with means for increasing heat-transfer area, e.g. with fins, with recesses, with corrugations (F28F 3/08{**F28F 3/08D**} takes precedence)

F28F 3/022 . . {the means being wires or pins}

F28F 3/025 . . {the means being corrugated, plate-like elements}

F28F 3/027 . . . {with openings, e.g. louvered corrugated fins; Assemblies of corrugated strips}

F28F 3/04 . . the means being integral with the element

F28F 3/042 . . . { in the form of local deformations of the element}

F28F 3/044 . . . . { the deformations being pontual, e.g. dimples}

F28F 3/046 . . . . { the deformations being linear, e.g. corrugations}

F28F 3/048 . . . { in the form of ribs integral with the element or local variations in thickness of the element, e.g. grooves, microchannels}

F28F 3/06 . . the means being attachable to the element

F28F 3/08 . Elements constructed for building-up into stacks, e.g. capable of being taken apart for cleaning

F28F 3/083 . . {capable of being taken apart}

F28F 3/086 . . {having one or more openings therein forming tubular heat-exchange passages}

F28F 3/10 . . Arrangements for sealing the margins

F28F 3/12 . Elements constructed in the shape of a hollow panel, e.g. with channels {(F28D 1/02, F28D 1/03 take precedence)}

F28F 3/14 . . by separating portions of a pair of joined sheets to form channels, e.g. by inflation (manufacture thereof B23P)

F28F 5/00 **Elements specially adapted for movement** (arrangements for moving the elements, see the appropriate subclass for the apparatus concerned)

F28F 5/02 . Rotary drums or rollers

F28F 5/04 . Hollow impellers, e.g. stirring vane

F28F 5/06 . Hollow screw conveyers

F28F 7/00 **Elements not covered by group F28F 1/00, F28F 3/00 or F28F 5/00**

F28F 7/02 . Blocks traversed by passages for heat-exchange media {(F28D 7/0008 takes precedence)}

F28F 9/00 **Casings; Header boxes; Auxiliary supports for elements; Auxiliary members within casings**

F28F 9/001 . { Casings in the form of plate-like arrangements; Frames enclosing a heat exchange core}

F28F 9/002 . . {with fastening means for other structures}

F28F 9/005 . { Other auxiliary members within casings, e.g. internal filling means or sealing means}

F28F 9/007 . Auxiliary supports for elements

F28F 9/0075 . . {Supports for plates or plate assemblies}

F28F 9/013 . . for tubes or tube-assemblies

F28F 9/0131 . . . { formed by plates (F28F 9/0138 takes precedence)}

F28F 9/0132 . . . {formed by slats, tie-rods, articulated or expandable rods}

F28F 9/0133 . . . {formed by concentric strips}

F28F 9/0135 . . . {formed by grids having only one tube per closed grid opening (F28F 9/0132 and F28F 9/0133 take precedence)}

F28F 9/0136 . . . . {formed by intersecting strips}

F28F 9/0137 . . . {formed by wires, e.g. helically coiled (F28F 9/0135 takes precedence)}

F28F 9/0138 . . . { formed by sleeves for finned tubes}

F28F 9/02 . Header boxes; End plates

F28F 9/0202 . . {Header boxes having their inner space divided by partitions}

F28F 9/0204 . . . {for elongated header box, e.g. with transversal and longitudinal partitions}

F28F 9/0207 . . . . { the longitudinal or transversal partitions being separate elements attached to header boxes (F28F 9/0212, F28F 9/0217 take precedence)}

F28F 9/0209 . . . . {having only transversal partitions}

F28F 9/0212 . . . . . {the partitions being separate elements attached to header boxes}

F28F 9/0214 . . . . {having only longitudinal partitions}

F28F 9/0217 . . . . . {the partitions being separate elements attached to header boxes}

F28F 9/0219 . . {Arrangements for sealing end plates into casing or header box; Header box

sub-elements (F28F 9/0236 takes precedence)}

F28F 9/0221 . . . {Header boxes or end plates formed by stacked elements}

F28F 9/0224 . . . {Header boxes formed by sealing end plates into covers (F28F 9/0221 takes precedence)}

F28F 9/0226 . . . . {with resilient gaskets}

F28F 9/0229 . . {Double end plates; Single end plates with hollow spaces}

F28F 9/0231 . . {Header boxes having an expansion chamber}

F28F 9/0234 . . {having a second heat exchanger disposed there within, e.g. oil cooler}

F28F 9/0236 . . {floating elements}

F28F 9/0239 . . . {floating header boxes}

F28F 9/0241 . . . {floating end plates}

F28F 9/0243 . . {Header boxes having a circular cross-section}

F28F 9/0246 . . { Arrangements for connecting header boxes with flow lines}

F28F 9/0248 . . . { Arrangements for sealing connectors to header boxes}

F28F 9/0251 . . . { Massive connectors, e.g. blocks; Plate-like connectors}

F28F 9/0253 . . . . { with multiple channels, e.g. with combined inflow and outflow channels}

F28F 9/0256 . . . { Arrangements for coupling connectors with flow lines}

F28F 9/0258 . . . . { of quick acting type, e.g. with snap action}

F28F 9/026 . . { with static flow control means, e.g. with means for uniformly distributing heat exchange media into conduits}

F28F 9/0263 . . . { by varying the geometry or cross-section of header box}

F28F 9/0265 . . . { by using guiding means or impingement means inside the header box}

F28F 9/0268 . . . . { in the form of multiple deflectors for channeling the heat exchange medium}

F28F 9/027 . . . { in the form of distribution pipes}

F28F 9/0273 . . . . { with multiple holes}

F28F 9/0275 . . . . { with multiple branch pipes}

F28F 9/0278 . . . { in the form of stacked distribution plates or perforated plates arranged over end plates}

F28F 9/028 . . . { by using inserts for modifying the pattern of flow inside the header box, e.g. by using flow restrictors or permeable bodies or blocks with channels}

F28F 9/0282 . . . { by varying the geometry of conduit ends, e.g. by using inserts or attachments for modifying the pattern of flow at the conduit inlet or outlet}

F28F 9/04 . . Arrangements for sealing elements into header boxes or end plates { arrangements for sealing flow lines connectors to header boxes F28F 9/0248}

F28F 9/06 . . . by dismountable joints

F28F 9/08 . . . . by wedge-type connections, e.g. taper ferrule

F28F 9/10 . . . . by screw-type connections, e.g. gland

F28F 9/12 . . . . by flange-type connections

F28F 9/14 . . . . by force-joining

F28F 9/16 . . . by permanent joints, e.g. by rolling (metal-working procedures in general B21, B32; particularly B21D 39/06, B23K)

F28F 9/162 . . . . {by using bonding or sealing substances, e.g. adhesives (F28F 9/18 takes precedence)}

F28F 9/165 . . . . {by using additional preformed parts, e.g. sleeves, gaskets (F28F 9/185 takes precedence)}

F28F 9/167 . . . . . {the parts being inserted in the heat-exchange conduits}

F28F 9/18 . . . . by welding

F28F 9/182 . . . . . {the heat-exchange conduits having ends with a particular shape, e.g. deformed; the heat-exchange conduits or end plates having supplementary joining means, e.g. abutments}

F28F 9/185 . . . . . {with additional preformed parts}

F28F 9/187 . . . . . {at least one of the parts being non-metallic, e.g. heat-sealing plastic elements}

F28F 9/20 . Arrangements of heat reflectors, e.g. separately-insertible reflecting walls

F28F 9/22 . Arrangements for directing heat-exchange media into successive compartments, e.g. arrangements of guide plates

F28F 9/24 . Arrangements for promoting turbulent flow of heat-exchange media, e.g. by plates (F28F 1/38 takes precedence; in general F15D)

F28F 9/26 . Arrangements for connecting different sections of heat-exchange elements, e.g. of radiators (connecting different sections in water heaters F24H 9/14, {connecting headers with inlet or outlet fittings **F28F 9/04B**})

F28F 9/262 . . { for radiators (F28D 1/0408 takes precedence)}

F28F 9/264 . . . {by sleeves, nipples}

F28F 9/266 . . . {by screw-type connections}

F28F 9/268 . . . {by permanent joints, e.g. by welding}

F28F 11/00 **Arrangements for sealing leaky tubes and conduits** (stopping flow from or in pipes in general F16L 55/10)

F28F 11/02 . using obturating elements, e.g. washers, inserted and operated independently of each other (F28F 11/06 takes precedence)

F28F 11/04 . using pairs of obturating elements, e.g. washers, mounted upon central operating rods (F28F 11/06 takes precedence)

F28F 11/06 . using automatic tube obturating appliances

F28F 13/00 **Arrangements for modifying heat-transfer, e.g. increasing, decreasing** (F28F 1/00 to F28F 11/00 take precedence)

F28F 13/003 . {by using permeable mass, perforated or porous materials (F28F 13/18 takes precedence)}

F28F 13/02 . by influencing fluid boundary (boundary-layer control in general F15D)

F28F 13/04 . by preventing the formation of continuous films of condensate on heat-exchange surfaces, e.g. by promoting droplet formation {F28F 13/18 takes precedence}

F28F 13/06 . by affecting the pattern of flow of the heat-exchange media {(F28F 13/003 takes

precedence; static flow control means in header boxes F28F 9/026)}

F28F 13/08 . . by varying the cross-section of the flow channels

F28F 13/10 . . by imparting a pulsating motion to the flow, e.g. by sonic vibration

F28F 13/12 . . by creating turbulence, e.g. by stirring, by increasing the force of circulation (F28F 13/08 takes precedence)

F28F 13/125 . . . {by stirring}

F28F 13/14 . by endowing the walls of conduits with zones of different degrees of conduction of heat

F28F 13/16 . by applying an electrostatic field to the body of the heat-exchange medium

F28F 13/18 . by applying coatings, e.g. radiation-absorbing, radiation-reflecting; by surface treatment, e.g. polishing

F28F 13/182 . . {especially adapted for evaporator or condenser surfaces (F28F 13/187 takes precedence)}

F28F 13/185 . . {Heat-exchange surfaces provided with microstructures or with porous coatings}

F28F 13/187 . . . {especially adapted for evaporator surfaces or condenser surfaces, e.g. with nucleation sites}

F28F 17/00 **Removing ice or water from heat-exchange apparatus**

F28F 17/005 . {Means for draining condensates from heat exchangers, e.g. from evaporators (F28B 9/08 takes precedence)}

F28F 19/00 **Preventing the formation of deposits or corrosion, e.g. by using filters** {or scrapers}

F28F 19/002 . {by using inserts or attachments}

F28F 19/004 . {by using protective electric currents, voltages, cathodes, anodes, electric short-circuits}

F28F 19/006 . {Preventing deposits of ice}

F28F 19/008 . {by using scrapers}

F28F 19/01 . by using means for separating solid materials from heat-exchange fluids, e.g. filters

F28F 19/02 . by using coatings, e.g. vitreous or enamel coatings

F28F 19/04 . . of rubber; of plastics material; of varnish

F28F 19/06 . . of metal

F28F 21/00 **Constructions of heat-exchange apparatus characterised by the selection of particular materials** {(coatings for modifying heat-transfer F28F 13/18; coatings for preventing the formation of deposits or corrosion F28F 19/02)}

F28F 21/003 . {for domestic or space-heating systems}

F28F 21/006 . {of glass}

F28F 21/02 . of carbon, e.g. graphite

F28F 21/04 . of ceramic; of concrete; of natural stone
F28F 21/045 . . {for domestic or space-heating systems}

F28F 21/06 . of plastics material
F28F 21/061 . . {for domestic or space-heating systems}
F28F 21/062 . . {the heat-exchange apparatus employing tubular conduits}
F28F 21/063 . . . {for domestic or space-heating systems}
F28F 21/065 . . {the heat-exchange apparatus employing plate-like or laminated conduits}
F28F 21/066 . . . {for domestic or space-heating systems}
F28F 21/067 . . {Details}
F28F 21/068 . . . {for domestic or space-heating systems}

F28F 21/08 . of metal
F28F 21/081 . . { Heat exchange elements made from metals or metal alloys}
F28F 21/082 . . . { from steel or ferrous alloys}
F28F 21/083 . . . . { from stainless steel}
F28F 21/084 . . . { from aluminium or aluminium alloys}
F28F 21/085 . . . { from copper or copper alloys}
F28F 21/086 . . . { from titanium or titanium alloys}
F28F 21/087 . . . { from nickel or nickel alloys}
F28F 21/088 . . {for domestic or space-heating systems}
F28F 21/089 . . { Coatings, claddings or bonding layers made from metals or metal alloys (F28F 19/06 takes precedence)}

F28F 23/00 **Features relating to the use of intermediate heat-exchange materials, e.g. selection of compositions** (heat-transfer, heat-exchange or heat-storage materials C09K 5/00)

F28F 23/02 . Arrangements for obtaining or maintaining same in a liquid state

F28F 25/00 **Component parts of trickle coolers** (arrangements for increasing heat transfer F28F 13/00; controlling arrangements F28F 27/00)

F28F 25/02 . for distributing, circulating, and accumulating liquid (spraying or atomising in general B05B, B05D)
F28F 25/04 . . Distributing or accumulator troughs
F28F 25/06 . . Spray nozzles or spray pipes
F28F 25/08 . . Splashing boards or grids, e.g. for converting liquid sprays into liquid films; Elements or beds for increasing the area of the contact surface (packing elements per se B01J 19/30, B01J 19/32)
F28F 25/082 . . . {Spaced elongated bars, laths; Supports therefor}
F28F 25/085 . . . {Substantially horizontal grids; Blocks}

F28F 25/087 . . . {Vertical or inclined sheets; Supports or spacers}

F28F 25/10 . for feeding gas or vapour

F28F 25/12 . . Ducts; Guide vanes, e.g. for carrying currents to distinct zones

F28F 27/00 **Control arrangements or safety devices specially adapted for heat-exchange or heat-transfer apparatus** (control arrangements in general G05)

F28F 27/003 . {specially adapted for cooling towers}

F28F 27/006 . {specially adapted for regenerative heat-exchange apparatus}

F28F 27/02 . for controlling the distribution of heat-exchange media between different channels ({ static flow control means in header boxes F28F 9/026}; arrangements of guide plates or guide vanes F28F 9/22, F28F 25/12)

F28F 99/00 **Subject matter not provided for in other groups of this subclass**

F28F 2001/00 **Tubular elements; Assemblies of tubular elements** (specially adapted for movement F28F 5/00)

F28F 2001/02 . Tubular elements of cross-section which is non-circular (F28F 1/08, F28F 1/10 take precedence)

F28F 2001/027 . . with dimples

F28F 2001/10 . Tubular lements and assemblies thereof with means for increasing heat-transfer area, e.g. with fins, with projections, with recesses (crimped or corrugated elements F28F 1/06, F28F 1/08)

F28F 2001/42 . . the means being both outside and inside the tubular element

F28F 2001/428 . . . Particular methods for manufacturing outside or inside fins

F28F 2009/00 **Casings; Header boxes; Auxiliary supports for elements; Auxiliary members within casings**

F28F 2009/001 . { Casings in the form of plate-like arrangements; Frames enclosing a heat exchange core}

F28F 2009/004 . . Common frame elements for multiple cores

F28F 2009/02 . Header boxes; End plates

F28F 2009/0285 . . Other particular headers or end plates

F28F 2009/0287 . . . having passages for different heat exchange media

F28F 2009/029 . . . with increasing or decreasing cross-section, e.g. having conical shape

F28F 2009/0292 . . . with fins

F28F 2009/0295 . . . comprising cooling circuits

F28F 2009/0297 . . . Side headers, e.g. for radiators having conduits laterally connected to common

header

F28F 2009/22 . Arrangements for directing heat-exchange media into successive compartments, e.g. arrangements of guide plates

F28F 2009/222 . . Particular guide plates, baffles or deflectors, e.g. having particular orientation relative to an elongated casing or conduit

F28F 2009/224 . . . Longitudinal partitions

F28F 2009/226 . . . Transversal partitions

F28F 2009/228 . . . Oblique partitions

F28F 2013/00 **Arrangements for modifying heat-transfer, e.g. increasing, decreasing** (F28F 1/00 to F28F 11/00 take precedence)

F28F 2013/001 . Particular heat conductive materials, e.g. superconductive elements (for thermal joints F28F 2013/006)

F28F 2013/005 . Thermal joints

F28F 2013/006 . . Heat conductive materials

F28F 2013/008 . . Variable conductance materials; Thermal switches

F28F 2025/00 **Component parts of trickle coolers** (arrangements for increasing heat transfer F28F 13/00; controlling arrangements F28F 27/00)

F28F 2025/005 . Liquid collection; Liquid treatment; Liquid recirculation; Addition of make-up liquid

F28F 2200/00 **Prediction; Simulation; Testing** (measuring quantity of heat conveyed by flowing mediums G01K 17/06)

F28F 2200/005 . Testing heat pipes

F28F 2210/00 **Heat exchange conduits**

F28F 2210/02 . with particular branching, e.g. fractal conduit arrangements

F28F 2210/04 . Arrangements of conduits common to different heat exchange sections, the conduits having channels for different circuits

F28F 2210/06 . having walls comprising obliquely extending corrugations, e.g. in the form of threads

F28F 2210/08 . Assemblies of conduits having different features

F28F 2210/10 . Particular layout, e.g. for uniform temperature distribution

F28F 2215/00 **Fins**

F28F 2215/02 . Arrangements of fins common to different heat exchange sections, the fins being in contact with different heat exchange media

F28F 2215/04 . Assemblies of fins having different features, e.g. with different fin densities

F28F 2215/06 . Hollow fins; fins with internal circuits

F28F 2215/08 . with openings, e.g. louvers (zig-zag fins with openings F28F 1/128, common transversal fins with openings F28F 1/325, corrugated fins with openings F28F 3/027)

F28F 2215/10 . Secondary fins, e.g. projections or recesses on main fins

F28F 2215/12 . with U-shaped slots for laterally inserting conduits

F28F 2215/14 . in the form of movable or loose fins

F28F 2220/00 **Closure means, e.g. end caps on header boxes or plugs on conduits**

F28F 2225/00 **Reinforcing means**

F28F 2225/02 . for casings

F28F 2225/04 . for conduits

F28F 2225/06 . for fins

F28F 2225/08 . for header boxes

F28F 2230/00 **Sealing means**

F28F 2235/00 **Means for filling gaps between elements, e.g. between conduits within casings**

F28F 2240/00 **Spacing means**

F28F 2245/00 **Coatings; Surface treatments**

F28F 2245/02 . hydrophilic

F28F 2245/04 . hydrophobic

F28F 2245/06 . having particular radiating, reflecting or absorbing features, e.g. for improving heat transfer by radiation

F28F 2245/08 . self-cleaning

F28F 2250/00 **Arrangements for modifying the flow of the heat exchange media** (in general F28F 13/06)**, e.g. flow guiding means** (in casings F28F 9/22)**; Particular flow patterns**

F28F 2250/02 . Streamline-shaped elements

F28F 2250/04 . Communication passages between channels

F28F 2250/06 . Derivation channels, e.g. bypass

F28F 2250/08 . Fluid driving means, e.g. pumps, fans

F28F 2250/10 . Particular pattern of flow of the heat exchange media
F28F 2250/102 . . with change of flow direction
F28F 2250/104 . . with parallel flow
F28F 2250/106 . . with cross flow
F28F 2250/108 . . with combined cross flow and parallel flow

F28F 2255/00 **Heat exchanger elements made of materials having special features or resulting from particular manufacturing processes**

F28F 2255/02 . Flexible elements

F28F 2255/04 . comprising shape memory alloys or bimetallic elements

F28F 2255/06 . composite, e.g. polymers with fillers or fibres

F28F 2255/08 . pressed; stamped; deep-drawn

F28F 2255/10 . made by hydroforming

F28F 2255/12 . expanded or perforated metal plate

F28F 2255/14 . molded
F28F 2255/143 . . injection molded
F28F 2255/146 . . overmolded

F28F 2255/16 . extruded

F28F 2255/18 . sintered

F28F 2255/20 . with nanostructures

F28F 2260/00 **Heat exchangers or heat exchange elements having special size, e.g. microstructures** (micro heat pipes F28D 2015/0225; nanostructures F28F 2255/20)

F28F 2260/02 . having microchannels

F28F 2265/00 **Safety or protection arrangements; Arrangements for preventing malfunction** (control or monitoring devices F28F 27/00)

F28F 2265/02 . in the form of screens or covers (heat shields F28F 2265/10)

F28F 2265/06 . by using means for draining heat exchange media from heat exchangers

F28F 2265/10 . for preventing overheating, e.g. heat shields (thermal insulation F28F 2270/00)

F28F 2265/12 . for preventing overpressure

F28F 2265/14 . for preventing damage by freezing, e.g. for accommodating volume expansion

F28F 2265/16 . for preventing leakage

F28F 2265/18 . for removing contaminants, e.g. for degassing

F28F 2265/20 . for preventing development of microorganisms

F28F 2265/22 . for draining

F28F 2265/24 . for electrical insulation

F28F 2265/26 . for allowing differential expansion between elements (floating header box elements F28F 9/0236)

F28F 2265/28 . for preventing noise (by preventing vibrations F28F 2265/30)

F28F 2265/30 . for preventing vibrations

F28F 2265/32 . for limiting movements, e.g. stops, locking means

F28F 2270/00 **Thermal insulation; Thermal decoupling**

F28F 2270/02 . by using blind conduits

F28F 2275/00 **Fastening; Joining**

F28F 2275/02 . by using bonding materials (brazing F28F 2275/04); by embedding elements in particular materials

F28F 2275/025 . . by using adhesives

F28F 2275/04 . by brazing (brazing heat exchangers B23K 1/0012)

F28F 2275/045 . . with particular processing steps, e.g. by allowing displacement of parts during brazing or by using a reservoir for storing brazing material

F28F 2275/06 . by welding (welding heat exchangers **L23K 101/14**)

F28F 2275/061 . . by diffusion bonding

F28F 2275/062 . . by impact pressure or friction welding
F28F 2275/064 . . by induction welding or by using microwaves
F28F 2275/065 . . by ultrasonic or vibration welding
F28F 2275/067 . . by laser welding
F28F 2275/068 . . by explosive welding

F28F 2275/08 . by clamping or clipping
F28F 2275/085 . . with snap connection

F28F 2275/10 . by force joining

F28F 2275/12 . by methods involving deformation of the elements
F28F 2275/122 . . by crimping, caulking or clinching
F28F 2275/125 . . by bringing elements together and expanding
F28F 2275/127 . . by shrinking

F28F 2275/14 . by using form fitting connection, e.g. with tongue and groove
F28F 2275/143 . . with pin and hole connections
F28F 2275/146 . . with bayonet connections

F28F 2275/16 . with toothed elements, e.g. with serrations

F28F 2275/18 . by using wedge effect

F28F 2275/20 . with threaded elements
F28F 2275/205 . . with of tie-rods

F28F 2275/22 . by using magnetic effect

F28F 2280/00 Mounting arrangements; Arrangements for facilitating assembling or disassembling of heat exchanger parts

F28F 2280/02 . Removable elements

F28F 2280/04 . Means for preventing wrong assembling of parts

F28F 2280/06 . Adapter frames, e.g. for mounting heat exchanger cores on other structure and for allowing fluidic connections

F28F 2280/08 . Tolerance compensating means

F28F 2280/10 . Movable elements, e.g. being pivotable (elements specially adapted for movements F28F 5/00)
F28F 2280/105 . . with hinged connections